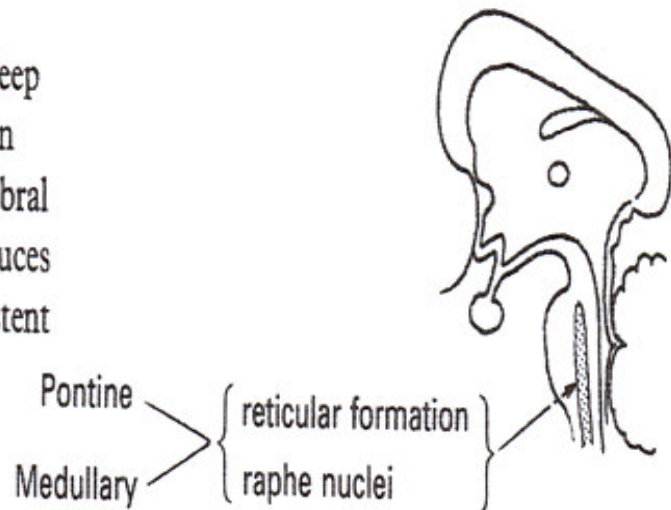


PHYSIOLOGY

Sleep results from activity in certain sleep producing areas of the brain rather than from reduced sensory input to the cerebral cortex. Stimulation of these areas produces sleep; damage results in states of persistent wakefulness.



RETICULAR FORMATION :

Ascending part of RF responsible for awareness & consciousness

Two states of sleep are recognised:

1. Rapid eye movement (REM) sleep

Characterised by: – Rapid conjugate eye movement
– Fluctuation of temperature, BP, heart rate and respiration
– Muscle twitching
– Presence of dreams

Originates in: – Pontine reticular formation

Mediated by: – Noradrenaline , Ach

2. Non-rapid eye movement (non-REM) sleep

– Absence of eye movement
– Stability of temperature, BP, heart rate and respiration
– Absence of muscle twitching
– Absence of dreams

– Midline pontine and medullary nuclei (raphe nuclei)

– Serotonin

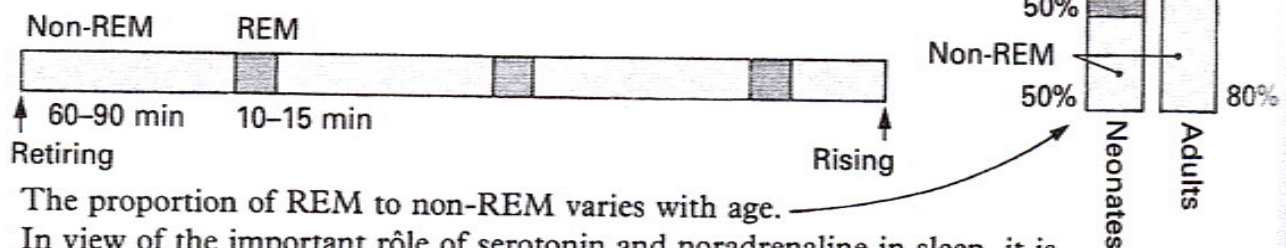
PHYSIOLOGY TEAM - SLEEP

The **electroencephalogram** shows characteristic patterns which correspond to the type and depth of sleep.

REM sleep		a low voltage record with mixed frequencies, dominated by fast activity.
Non-REM sleep		
Drowsiness		a relatively low voltage record with slow rhythms, interrupted by alpha rhythm.
Intermediate		sharp waves evident in vertex leads (V waves).
Deep sleep		a high voltage record dominated by slow wave activity.

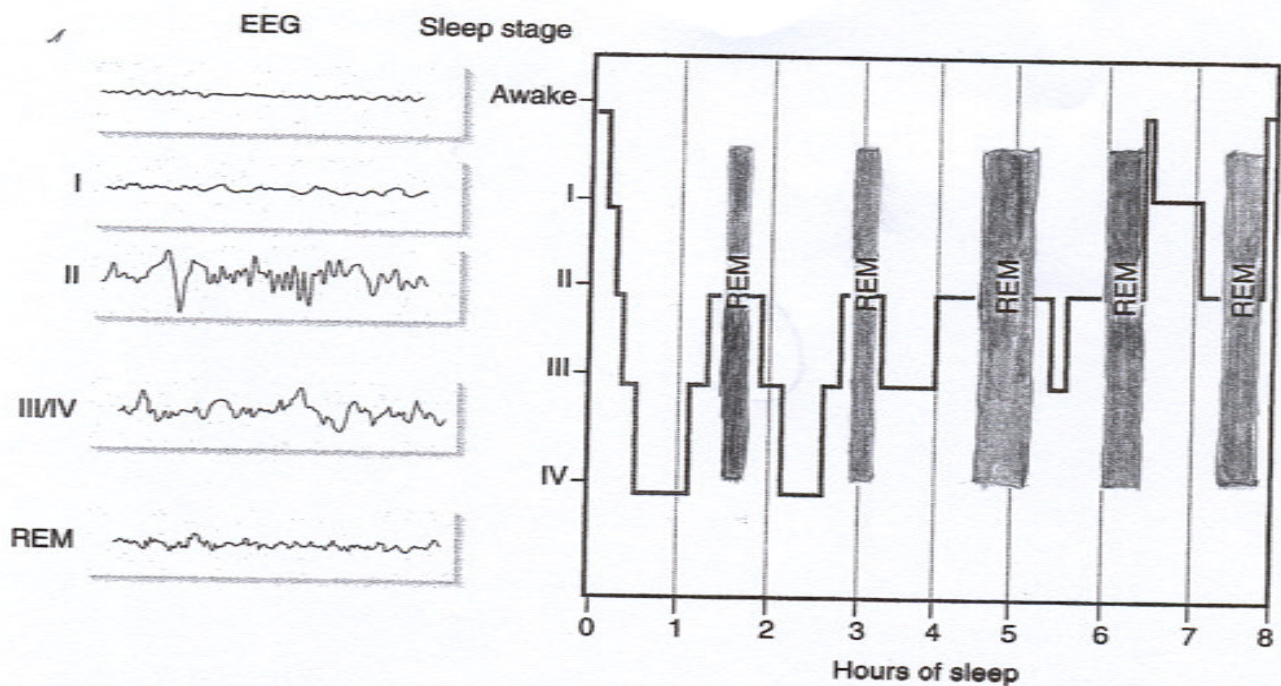
The sleep pattern

In adults non-REM and REM sleep alternate throughout the night.



The proportion of REM to non-REM varies with age.

In view of the important rôle of serotonin and noradrenaline in sleep, it is understandable that drugs may affect the duration and/or content of sleep.



15-3: Sleep architecture is accompanied by distinctive changes in electroencephalogram (EEG) activity. REM, rapid eye movement.

VI. Sleep

A. Stages (Fig. 15-3)

1. Determined by **polysomnogram**
 - a. EEG measures activity in the cerebral cortex.
 - b. Electrooculogram (EOG) measures eye movement.
 - c. Electromyogram (EMG) measures muscle activity.
2. **Awake, active mental state:** EEG shows high-frequency, low-amplitude beta waves (15–40 Hz).
3. **Relaxed, waking state:** EEG shows high-frequency, low-amplitude alpha waves (8–13 Hz).
4. **Non-rapid eye movement (NREM) stage 1 (drowsiness to light sleep):**
 - a. EEG shows high-frequency, low-amplitude theta waves (3–7 Hz).
 - b. Hypnic myoclonic contractions possible
5. **NREM stage 2 (light sleep)**
 - a. EEG contains sleep spindles (12–14 Hz).
 - b. Limited eye and body movement
6. **NREM stage 3 + 4 (deep sleep, slow-wave sleep)**
 - a. EEG shows low-frequency, high-amplitude delta waves (2 Hz).
 - b. Stage 3 has up to 50%, and stage 4 has more than 50% delta waves.
 - c. Difficult to wake spontaneously
 - d. No eye movement and limited body movement
 - e. Parasympathetic control dominates, with slowed heart rate
 - f. Influenced by prior wakefulness: sleep deprivation causes increased stage 4 sleep.
 - g. **Night terrors** and somnambulism (**sleepwalking**) possible
 - h. Stage 4 is **suppressed by benzodiazepines**

7. REM sleep

- a. Also called desynchronized, activated, or **paradoxical** sleep
- b. EEG shows high-frequency, low-voltage pattern that is very **similar to waking** beta-wave EEG.
- c. **Atonia due to paralysis of muscles**, excluding middle ear and eye and respiratory muscles, controlled from brainstem
- d. Dominates prenatally
- e. Sympathetic activity dominates.
- f. Penile erection
- g. Thermoregulatory control decreased
- h. Not influenced by prior wakefulness
- i. Vivid visual dreaming
 - (1) Paralysis prevents acting out dreams
 - (2) **REM sleep disorder**: loss of REM paralysis allows individual to act out dreams.
- j. **Suppressed by alcohol, barbiturates, and tricyclic antidepressants**

Individuals are most likely to wake spontaneously from REM sleep, even though REM is the deepest sleep.

B. Sleep architecture (see Fig. 15-3)

- 1. Normal: 90-minute cycle beginning with stage 1 - 2 - 3 - 4 - 3 - 2—REM
- 2. First REM sleep is normally entered about 90 minutes into sleep.

Individuals with REM sleep disorder or depression have early-onset REM sleep.

C. EEG

- 1. Frequency varies with different stages of sleep
- 2. **Beta** (13–30 Hz) awake, active (“desynchronized”)
- 3. **Alpha** (8–13 Hz) awake, relaxed
- 4. **Theta** (4–7 Hz) sleep stages 1 and 2
- 5. **Delta** (0.5–4 Hz) sleep stages 3 and 4 (“synchronized”)

D. Disorders

1. Insomnia

a. Definition

- (1) Inability to achieve sufficient sleep
- (2) Subjective sense of insufficient sleep
- (3) Difficulty in falling asleep (30 minutes or more)
- (4) Symptom, not a disorder

b. Causes

- (1) Anxiety, depression, stress, pain
- (2) Side effect of drugs, alcohol, poor sleep habits
- (3) Disruption of circadian rhythms
- (4) Increasing age

c. Effects

- (1) Problems with memory and concentration
- (2) Potential link with cardiovascular disease
- (3) Four-fold increase in likelihood of depression
- (4) Impaired performance

- d. **Fatal familial insomnia** is a rare prion-mediated disorder that affects numerous brain regions, including thalamus.

2. Sleep apnea

- a. Consists of **brief periods of interrupted breathing** during sleep

- b. Diagnosed using polysomnogram and multiple sleep latency test: normal sleep latency is 10 to 20 minutes; sleep-deprived is less than 5 minutes

c. Obstructive sleep apnea

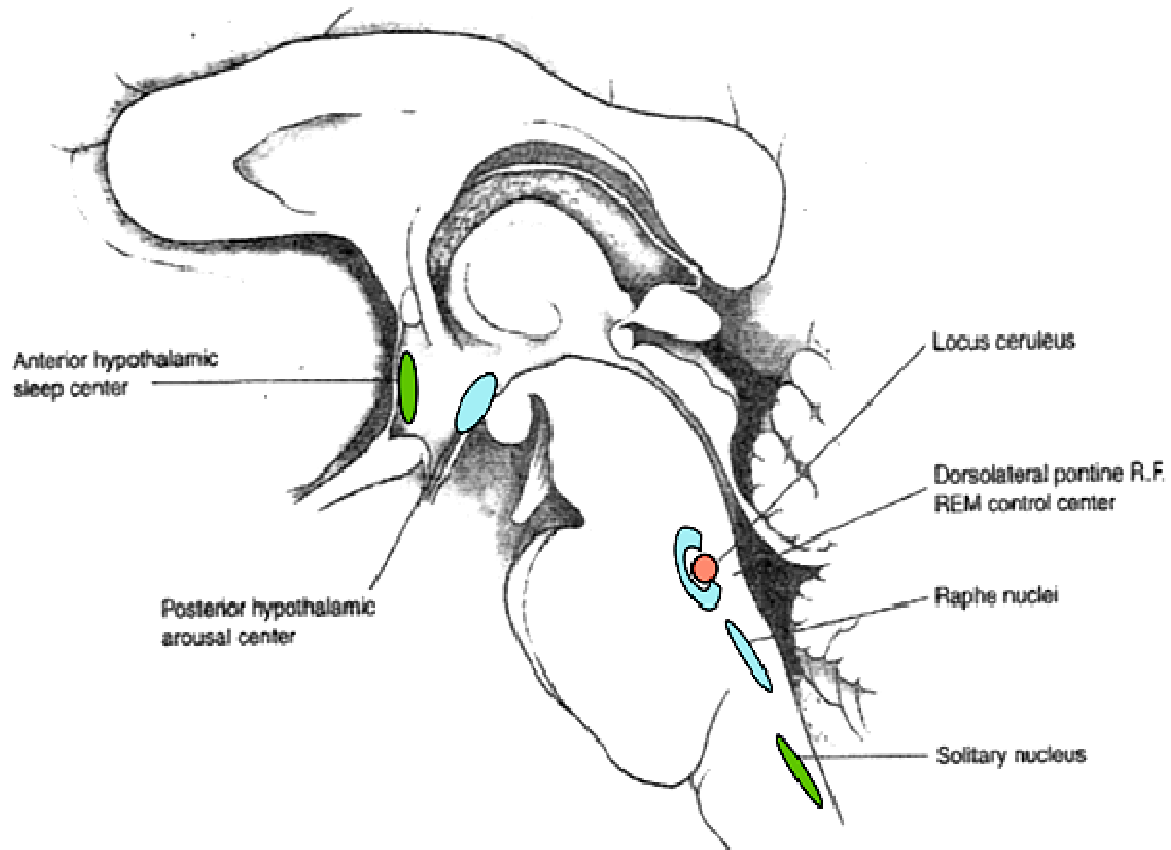
- (1) **Major cause of daytime sleepiness**
- (2) Waking up to 500 times per night
- (3) Often accompanies heavy snoring
- (4) More common in **overweight individuals**

- d. **Treatment:** weight loss and continuous positive airway pressure

3. Narcolepsy

- a. Characterized by **sudden irresistible sleep attacks**; often 15 minutes of sleep refreshes
- b. **Second leading cause of daytime sleepiness**; affects about one in 2000 people, men and women of any age
- c. **Symptoms**
 - (1) **Excessive daytime sleepiness**
 - (2) Sleep latency is decreased on multiple sleep latency tests.
 - (3) **Sleep-onset REM** (REM normally occurs after 90 minutes of sleep)
 - (4) **Cataplexy**
 - (a) Sudden loss of muscle tone ranging from slight weakness (head droop, facial sagging, jaw drop, slurred speech, buckling of knees) to total collapse
 - (b) Triggered by intense emotion (laughter, anger, surprise, fear) or strenuous athletic activity
 - (5) Paralysis at sleep onset and offset
 - (6) Hypnagogic hallucinations

Patients with hypnagogic hallucinations report vivid and often frightening dreams and sounds when falling asleep.



NARCOLEPSY AND CATAPLEXY

Narcolepsy

An irresistible desire to sleep in inappropriate circumstances and places. Attacks occur suddenly and are of brief duration unless patient remains undisturbed.

Cataplexy

Sudden loss of postural tone. The patient crumples to the ground. Consciousness is preserved. Emotion – laughter or crying – can precipitate an attack.

The narcolepsy/cataplexy tetrad

Only 10% of patients manifest the complete tetrad

Sleep paralysis

On awakening, the patient is unable to move. This may last for 2–3 minutes.

Hypnagogic hallucinations

Vivid dreams or hallucinations occur as the patient falls asleep or occasionally when apparently awake.

PHYSIOLOGY TEAM - SLEEP

Drowsiness	Fluctuation in alpha rhythm, general frontocentral slowing, overall loss of voltage
Stage I	Vertex waves, positive occipital sharp transients of sleep (POSTS)
Stage II	Spindles and K complexes (vertex waves persist)
Stage III	Appearance of delta activity (spindles persist)
Stage IV	Greater than 50 percent delta activity (spindles fading)
REM	Low-voltage fast activity with no alpha, rapid lateral eye movements

SLEEP & EEG

- It can be represented by EEG .
 - EEG records fluctuation from excitatory or inhibitory potential from cortex.
 - Origin of alpha wave is from parieto-occipetal area.
 - Sleep spindle mean 2nd stage of sleep.
-
- ✓ BETA wave more than 20Hz ---> THINKING.
 - ✓ ALPHA wave 8-13 -----> RELAX .
 - ✓ THETA wave 4-7 Hz -----> DROWSY & SLEEP.
 - ✓ DELTA wave 2-4 Hz -----> SLEEP.